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Original Research Article

Compost Quality of Compost Process Grass Waste with Composting Bin Method

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Abstract
The increasing of organic waste can increase environmental pollution. This can be overcome by doing aerobic composting of organic waste. This was because the method includes a simple composting method in its application. The aim of this study is to analyze the quality of compost from grass waste. In this study, composting of grass waste, banana leaf waste and cotton waste has been carried out aerobically with the waste composting method. The compost material consisted of 76% grass waste, 12% banana leaf waste and 12% cotton waste with the addition of EM4 0, 10 and 50 mL/Kg doses of compost material. Monitoring of quality compost consist of temperature, pH, moisture content, C/N ratio, phosphor and potassium. Analysis of compost quality in this study refers to SNI 19-7030-2004. The results showed that the quality of compost without the addition of EM4 was the best compost quality of all the variables in this study.

Keywords: Compost; grass waste; banana leaf waste; cotton waste

1. Introduction
The yarn spinning industry in Indonesia still uses 95% of imported cotton fiber products. In 2014, Indonesia's cotton imports reached 700.000 tons. Cotton fiber that has been processed into yarn, will produce 4–5% or 28.000–35.000 tons of non-reusable waste (Mutia et al., 2018). Cotton waste is an organic waste that is rich in cellulose content. So far, it has not been widely used; therefore the amount of cotton waste is still very large (Arifin et al., 2014). Besides cotton, there is still a lot of waste from banana plantations that has not been processed.

Banana (Musa Balbisiana) is the most common type of fruit found in urban to rural areas (Julfan et al., 2016). This plant can grow in tropical and subtropical areas. In 2020, the Central Statistics Agency stated that the production of banana plants in East Java reached 2.618. 795 tons. The large number of bananas produced causes new problems. One of these problems is dried banana leaf waste. Dried banana leaf waste from dried banana trees is simply piled up and burned, so it can pollute the air (Marlina et al., 2021). To overcome the problem of cotton waste and dry banana leaf waste, further processing is needed to reduce the generation of such waste. One method that can be used is composting.

Composting cotton waste and dried banana leaves aims to reduce the amount of waste generated. In addition to reducing the amount of generation, the compost that has been produced can add nutrients to the soil. Compost can increase the value of nitrogen, phosphorus, potassium, magnesium, calcium, and soil pH (Wijaya et al., 2017). Banana leaf waste contains C-Organic by 32.93%, N-Total by 1.20%, so that the C/N ratio is 27.4% (Darma et al., 2020). To support the quality of compost, it is necessary to add grass waste.

Grass waste is a weed that causes harm to the growth of other plants. Therefore, it is used as a mixture of compost material so that becomes more useful. Rabbit manure has the potential to be composted because it has a C/N ratio between 10% and 12%. (Sajimin et al., 2005). This study also used EM4 solution as a bio activator. This study aims to analyze the quality of compost from cotton, banana leaves, grass Waste. The parameters that were analyzed in this study were pH, C/N ratio, phosphorus, potassium values, and physical characteristics including temperature and moisture content of the compost.

2. Methodology

Methodology research in this study beginning make design composter reactor. This step, composter reactor was suitable with volume of material compost and type of composting. After that. This research determines composition percentages of material compost for composting. Material compost in this study was cotton waste, banana leaf waste and grass waste. The composting process was running for 30 days. Monitoring of the composting process has done which it consist of temperature, pH, moisture content, C, N, P and K of compost. Finally, that compost quality was comparison with SNI 19-7030-2004.

2.1. Composter Reactor

The reactor used in this study has dimensions of length, width and height, 60, 40, 40 cm, respectively. Most of the sides of the reactor are coated with paranet so that the compost can get a good enough air supply. The front of the reactor is covered by wooden planks to support the construction of the reactor to make it stronger. As for the cover, use a paranet layer to prevent unwanted insects/animals from interfering with the composting process.

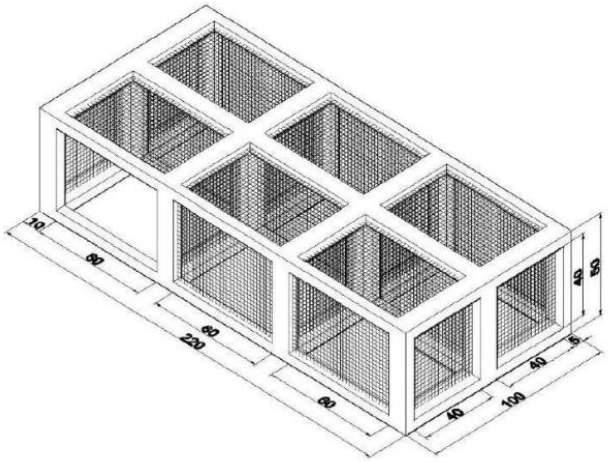

Figure 1. Composting bin reactor

2.2. Material Compost

The compost materials in this study were grass waste, cotton waste and banana leaf waste. The characteristics of the waste affect the duration of composting. In this study, measurements of the content of C, N and water content of the waste were carried out. The following were the results of measuring the characteristics of the compost material in this study (can be seen in **Table 1.**)

Table 1. Characteristic of compost material

Compost material	Characteristic of compost material			
	C (%)	N (%)	C/N ratio	Moisture content (%)
Cotton waste	23,80	0.01	23.80	0.95
Banana leaf waste	44.20	0.86	51.40	8.64
Grass waste	25.85	1.66	15.57	11.88

After measurement of characteristic of compost material, determined the composition of the compost material. It can be determined by calculating the C/N ratio mix of the compost material. In this study, C/N mix approaches the ideal C/N 10-20 (SNI 19-7030-2004) which is 25. This is intended to make the composting process run faster and get compost quality in accordance with compost quality standards. Based on the results of the C/N mix calculation using the equation 1 (Tchobanoglous et al., 2002):

$$\frac{C/}{N} mix = \frac{C\ of\ \ banana\ leaf\ waste + C\ cotton\ waste + X\ C\ of\ grass\ waste}{N\ of\ \ banana\ leaf\ waste + N\ cotton\ waste + X\ N\ of\ grass\ waste} \quad (1)$$

Where :
C/N mix was C/N ratio of the grass waste, cotton and banana leaf waste
C = Weight of carbon
N = Weight of nitrogen
X = weight of grass waste mixed with 1 kg banana leaf waste and cotton waste

Based on the results of the calculation of the C/N ratio mix, the composition of the compost material in the study was cotton waste (12%), banana leaf waste (12%) and grass waste (76%). In this study there were 3 research variables which can be seen in **Table 2.**

Table 2. Research variable

Research variable	EM4 doses (mL/Kg compost material)		
	A1	A2	A3
Cotton waste (12%) Banana leaf waste (12%) Grass waste (76%)	0	10	50

2.3. Composting Process with Composting Bin Method

Material compost consist of cotton waste, grass waste, and banana leaf waste were chopped into small pieces to the size of 1-5 cm. The enumeration process is useful for expanding the microbial coverage of compost material, thereby accelerating the degradation process (Soemarno et al., 2021). Furthermore, in this composting process use EM4 solution. It was used to composting process. EM4 solution is mixed with the compost material. In this study, the doses of EM4 used were 0, 10 and 50 mL/Kg. In a previous study by Suryanto (2019) stated that at a dose of 10 mL/kg EM4 could give the best effect on changes in the C/N ratio. In addition, the results of research by Rulyana et al. (2017) showed that 50 mL of EM4 solution was able to decompose organic waste. Furthermore, the EM4 solution is mixed until it is perfectly evenly distributed then put the mixed waste composition into the aerobic composting bin.

The compost material was turned every day. This needs to be done because it aims to supply oxygen and to homogenize the compost. According to Soemarno et al. (2021), one of the parameters in accelerating the composting process is oxygen demand. Oxygen is needed to support the decomposition of organic matter by bacteria. In order to supply oxygen, it is necessary to turn the pile of compost material so that the material at the edges is carried to the center of the pile. After that, measurement of temperature and pH have done every two days, water content every 3 days, C/N of compost every week

for 1 month and measurement of phosphorus and potassium at the end of composting (4th week). Finally, analyzing the comparison of compost characteristics consisting of temperature, pH, moisture content, C/N, P and K with SNI 19-7030-2004.

3. Results and Discussion

3.1. Temperature

The stages of the composting process are divided into 3 stages, namely the heating stage which is dominated by mesophilic microorganisms, the thermophilic stage which is dominated by thermophilic microorganisms, and the cooling and maturation stage (Irawan, 2014). In **Figure 2**, it can be seen that on the 2nd to 14th day for A1, A2, and A3 the temperature increased from 33ºC to 38ºC. In the temperature range of 33ºC to 38ºC, there are types of mesophilic microorganisms that live, namely the Actinomycetes group. Actinomycetes species begin to live when there is an increase in temperature in the compost after 5 to 10 days (Siswati et al., 2009).

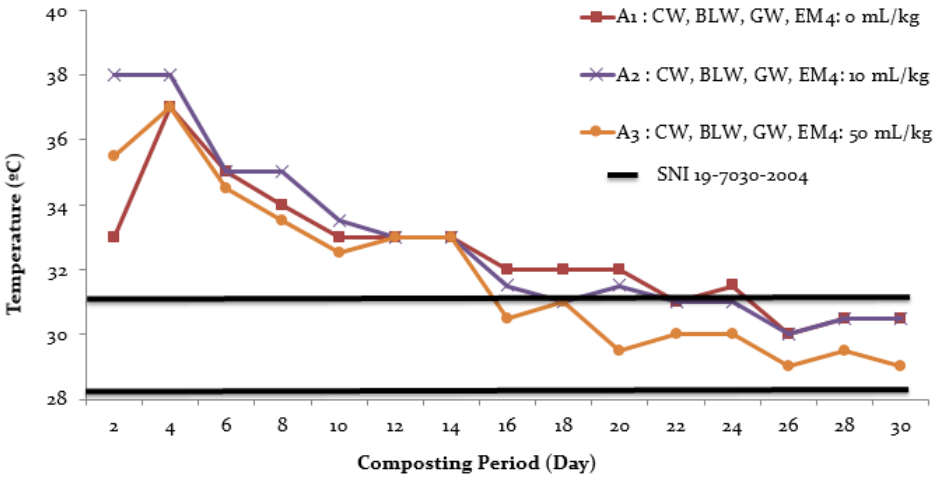

Figure 2. Comparison graph of compost temperature

Description:

a. CW = Cotton Waste
b. BLW = Banana Leaves Waste
c. GW = Grass Waste

Actinomycetes microorganisms function to accelerate the process of decomposition of organic waste in composting. The average value of compost temperature for A1, A2, and A3 is 32.5ºC; 32.8ºC; and 31.8ºC. This value indicates that the compost temperature at A2 with the composition of cotton waste, banana leaf waste, and grass waste and the addition of 10 mL/kg EM4 dose produces the highest average temperature value. A high-temperature value indicates that microorganisms are active in decomposing organic compost. Fizda et al. (2018) explain that temperature is an important factor in the composting process. This is because the temperature parameter can be seen in the performance of microorganisms in degrading organic matter. In the final week of composting, the temperature value of the compost is in the range of minimum soil temperature of 28.6ºC and maximum of 31.4ºC. This indicates that the compost has entered the ripening stage. It showed that this temperature in maturation/ mesophilic phase (USDA, 2000; Mehta and Kanak. 2018). In this study, maturity compost can got for 30 days.

3.2. Power of Hydrogen (pH)

In **Figure 3**, it can be seen that the average value of compost pH for A1, A2, and A3 is 7.2; 7.3; and 7,1. This value indicates that the pH of the compost at A3 with the composition of cotton waste, banana leaf waste, and grass waste with the addition of EM4 50 mL/kg has the lowest average pH value. This shows that at A3, the composting process of organic acids carried out by microorganisms is active

in the composting process, to reduce the pH value. Afrida et al. (2020) explained that changes in pH occur due to the activity of microorganisms in decomposing organic matter. There is a process of decomposition of organic matter in the form of amino acids and proteins which causes a low pH value. Furthermore, it forms NH_4^+ which was used by decomposing microorganisms to be able to form new cells, so that nitrate will be formed. The formation of nitrate causes a high pH value which causes alkaline compost conditions. Furthermore, leaching nutrient losses are primarily as bound nitrogen, ammonium ions ($NH4^+$), and small amounts of nitrates (NO_3) (USDA, 2000).

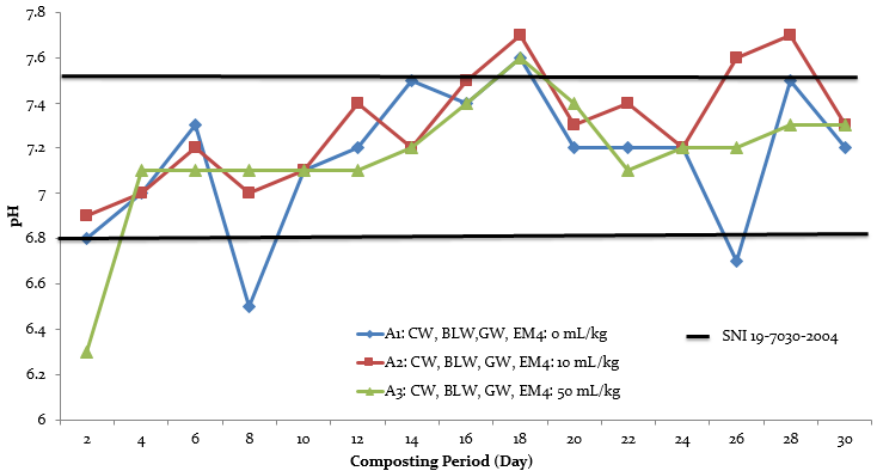

Figure 3. Potential hydrogen of compost

At the end of the composting process, the pH values for A1, A2, and A3 have complied with SNI 19-7030-2004 concerning Compost Specifications from Domestic Organic Waste. The results compost with the best treatment is the compost that has a pH value close to 7 according to the pH value of the soil (Aditya et al., 2015). The compost maturation phase occurs in the 4th week with the pH value meeting the standard of 7.47 (Mudhita et al., 2014).

3.3. Moisture Content

In **Figure 4**, it can be seen that the value of moisture content from day 6 and the next day continues to decrease. The decrease in moisture content can occur due to an increase in temperature which indicates the activity of microorganisms in composting. The decrease in moisture content causes the compost moisture to be below 40%. In addition, the moisture content can also affect the rate of composting decomposition and temperature parameters but does not affect pH (Ratna et al., 2017).

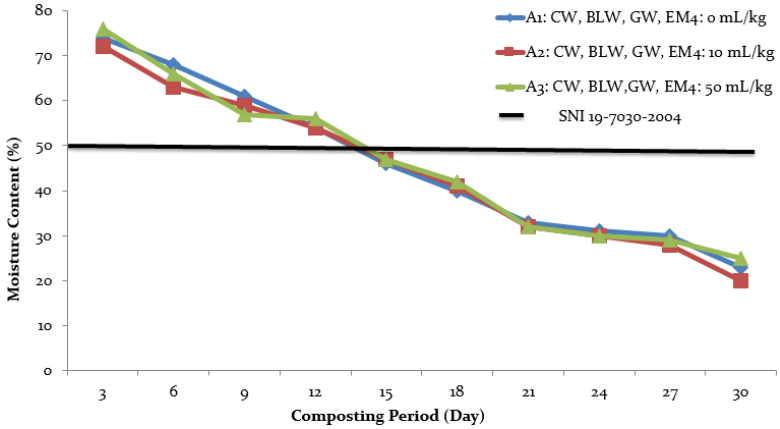

Figure 4. Moisture content of compost

The optimum moisture content of compost is in the range of 50% to 60% during the decomposition process. The moisture content of compost depends on the organic material used as

compost (Pandebesie et al., 2013). In addition, Mehta and Kanak 2018 explained that the composting process aerobic suitable have moisture content approximately 40-65%. When the compost has high moisture content, it is controlled by stirring the compost material (Fizda et al., 2018). In this research, composting process of moisture content in all reactor was 20-75%. It indicated that the moisture content of compost approach optimum moisture content in composting process. At the end of composting, , the moisture content of compost for A1 is 23%, A2 is 20%, and A3 is 25% has complied SNI 19-7030-2004 concerning Compost Specifications from Domestic Organic Waste.

3.4. C/N Ratio

The following is a graph of the C/N ratio of compost monitored from 1st to 4th week, which can be seen in **Figure 5**:

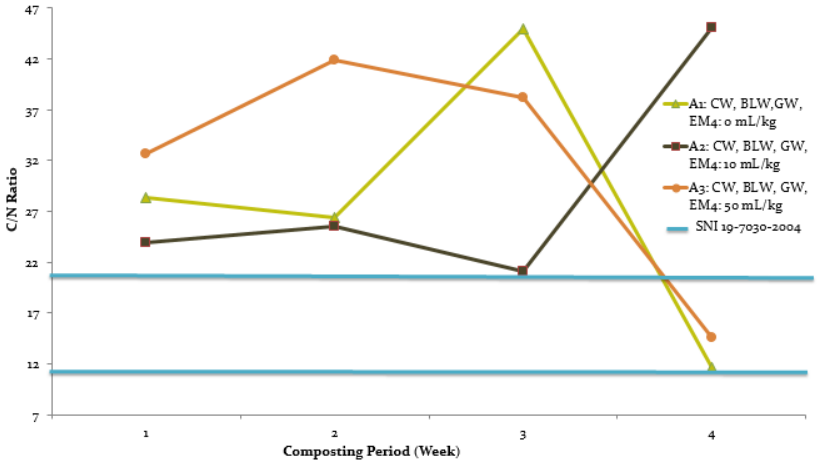

Figure 5. C/N ratio of compost

In Figure 5, it can be seen that the C/N ratio of compost at the end of composting for A1 and A3 has complied SNI, while for C/N ratio for A2 has not complied SNI. The final value of the C/N ratio for A1 is 11.68; A2 of 45.07; and A3 of 14.52. The value of the C/N ratio on A2 has a very high value. High levels of C/N ratio indicate that grass waste has lignocellulosic fibers consisting of 3 main components, namely lignin, hemicellulose, and cellulose which are relatively high, so the decomposition process takes longer. Lignin functions to fill the cavities between plant cells, so that plant tissues become hard and difficult to decompose by organisms. Organic matter has a high lignin content, resulting in the speed of the N mineralization process being hampered (Wawan, 2017). In this study, the C/N ratio in the A2 reactor was still high because the EM4 dose was not optimal. This causes the compost degradation process to take place slowly due to insufficient nitrogen in the microbial growth process (Chen et al., 2011).

The minimum and maximum values of the C/N ratio are 10 to 20 based on SNI 19-7030-2004 concerning compost specifications from domestic organic waste. In the 4th week, the value of the C/N ratio decreased. The decrease in the value of the C/N ratio in each reactor was due to a decrease in the amount of carbon used by microbes as an energy source (Widarti et al., 2015). The decrease in the amount of carbon occurs due to the decomposition process of organic waste material, this causes the value of the C/N ratio to be lower (Ismayana et al., 2012).

3.5. Phosphor

Figure 6 showed that the value of Phosphorus at the end of composting for A1 is 0.03%; A2 of 0.03%; and A3 of 0.02% has not complied the SNI. The minimum phosphorus content based on SNI 19-7030-2004 concerning Compost Specifications was 0.1%. The phosphorus content in compost was very low, this was because the composition of the compost material was less rich in phosphorus content. An example of an organic material rich in phosphorus is rabbit manure. This was to the results of research

by Kurniawan et al. (2013) explaining that the results of composting made from rabbit manure and jackfruit waste can increase the value of Phosphorus on compost quality. The presence of rabbit manure can increase the number of microbes as decomposers of organic matter so that more phosphate minerals are produced from microbial metabolism processes. For comparable with Trihadiningrum et al. (2015) it described that manure can be increasing phosphor of compost.

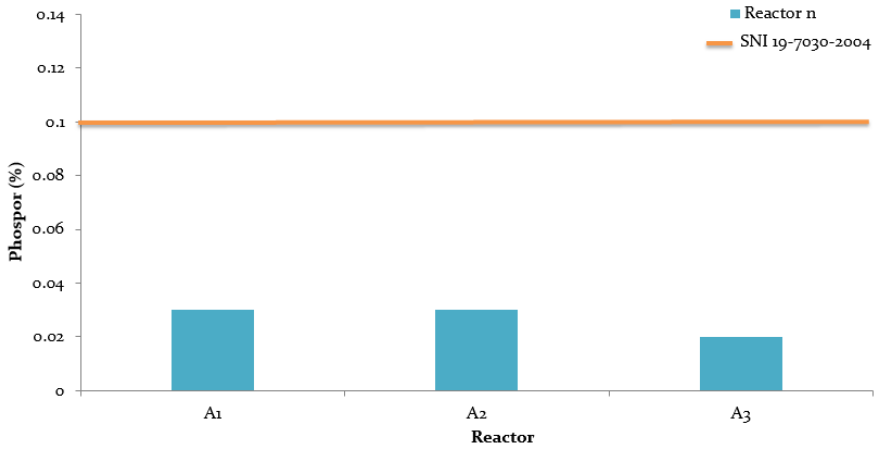

Figure 6. Compost of phospor

The process of decomposition of organic matter and the process of assimilation of Phosphorus can occur because there was a phosphatase enzyme produced by microorganisms. If the number of microorganisms in the compost material is reduced, the decomposition process of organic matter and the process phosphorus assimilation process decrease. Therefore, the phosphorus content is underutilized, on the other hand, if the number of microorganisms in the compost is sufficient, the process of overhauling organic matter will run perfectly (Tumimbang et al., 2016). The results of research by Bachtiar et al. (2019) explained that Phosphorus levels decreased, this happened because the decomposition of Phosphorus by microbes was not optimal.

3.6. Potassium

Figure 7. it can be seen that the value of Potassium at the end of composting for A1 is 1.37%; A2 is 1.51%, and A3 is 1.47% complied with the SNI because the value of Potassium is above 0.2%. The minimum Potassium content based on SNI 19-7030-2004 concerning Compost Specifications was 0.2%. The results of the compost at A1, A2, and A3 with grass material had a high Potassium value. This is because green organic matter, namely grass, is used in A1, A2, and A3. Based on the research of Kaswinarni et al. (2020) explained that the potassium content in compost comes from the basic material in the form of green plants. These green plants already contain the element K but are still in a complex form. The results of the analysis of mature compost research by Priadi et al. (2014) explained that compost made from grass and cow dung with a ratio of more grass material was able to produce the highest Potassium value compared to other variations. Potassium of compost was essential nutrient for plant growth (Irshad et al., 2011). In addition, Mirasari et al. (2021) explained that the compost contained complete macro and micro nutrients including potassium, this was because the compost material used comes from grass with the addition of a dose of EM4.

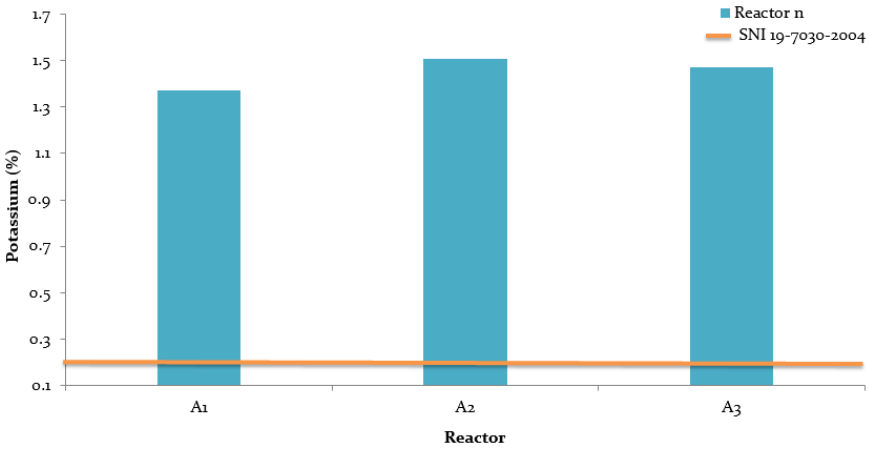

Figure 7. Compost of potassium

3.7. The Best Compost Results Based on SNI

The **Table 3.** showed that the compost parameters in A1 more complied SNI 19-7030-2004 than A2 and A3. So, it can be concluded that the quality of compost waste cotton, banana leaves, and grass without the addition of a dose of EM4 has the value of temperature, pH, water content, the ratio of C/N, S, N, P, and K has met the requirements of the National Compost Standard (SNI 19 - 7030-2004). The results of the research by Zulkarnain et al. (2013) said that compost with control treatment was better than compost treated with bioactivator dose. The results of the compost treatment dose of bioactivator when applied to the soil have not been able to improve the quality of the soil to be better than the quality of the soil given control compost. This indicated that the dose of bioactivator in compost needs to be increased to produce better quality compost according to the requirements of SNI 19- 7030-2004. It comparable with result of research Trihadiningrum et al. (2015), compost quality can be effect to soil conditioner.

Table 3. Compost analysis based on SNI

Reactor	Compost Parameters according to SNI 19-7030-2004								Total Checklist
	Temperature	pH	Moisture Content	C/N Ratio	C	N	P	K	
A1	✓	✓	✓	✓	✓	✓	×	✓	7
A2	✓	✓	✓	×	✓	×	×	✓	5
A3	✓	✓	✓	✓	×	✓	×	✓	6

Description

1. ✓= Complied
2. × = Has not complied

4. Conclusions

Quality compost of composting process with composting bin method in A1, A2, and A3 reactor was compiled the SNI 19- 7030-2004 which was consist of pH of compost (7.1 -7.3.), temperature of compost (31.8º-32.8ºC), moisture content of compost (20%,-25%) and potassium of compost (1.37%-1.51%), C/N ratio of compost in A1 (11.68) and A3 (14.52). In other hand, C/N ration of compost in A2 (45.07), phosphorus of compost in A1 (0.03%), A2 (0.03%) and A3 (0.02%) was not complied the SNI 19-7030-2004. Further research should be the composition of the compost material was added chicken manure. This was because chicken manure has higher phosphorus content than the compost material in this study.

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